APPENDIX B
DEPARTMENT OF ENERGY RADIATION PROTECTION STANDARDS AND CONCENTRATION GUIDES

DEPARTMENT OF ENERGY RADIATION PROTECTION STANDARDS AND CONCENTRATION GUIDES

Annual Effective Dose Equivalent Radiation Standards for Protection of the Public*

Continuous Exposure of Any Member of the Public	100 mrem/yr (1 mSv/yr)
Occasional Annual Exposure (less than 5 years duration)	500 mrem/yr (5 mSv/yr)

DOE Derived Concentration Guides (DCG) for Ingestion of Drinking Water and Inhaled Air (μCi/mL)

Radionuclide	In Air	In Water	Radionuclide	In Air	In Water
H-3	1 E-07	2 E-03	Eu-152	5 E-11	2 E-05
C-14	6 E-09	7 E-05	Eu-154	5 E-11	2 E-05
Fe-55	5 E-09	2 E-04	Eu-155	3 E-10	1 E-04
Co-60	8 E-11	5 E-06	Th-232	7 E-15	5 E-08
Ni-63	2 E-09	3 E-04	U-233	9 E-14	5 E-07
Sr-90	9 E-12	1 E-06	U-234	9 E-14	5 E-07
Zr-93	4 E-11	9 E-05	U-235	1 E-13	6 E-07
Nb-93m	4 E-10	3 E-04	U-236	1 E-13	5 E-07
Tc-99	2 E-09	1-E-04	U-238	1 E-13	6 E-07
Ru-106	3 E-11	6 E-06	Np-239	5 E-09	5 E-05
Rh-106m	6 E-08	2 E-04	Pu-238	3 E-14	4 E-08
Sb-125	1E-09	5 E-05	Pu-239	2 E-14	3 E-08
Te-125m	2 E-09	4 E-05	Pu-240	2 E-14	3 E-08
I-129	7 E-11	5 E-07	Pu-241	1 E-12	2 E-06
Cs-134	2 E-10	2 E-06	Am-241	2 E-14	3 E-08
Cs-135	3 E-09	2 E-05	Am-243	2 E-14	3 E-08
Cs-137	4 E-10	3 E-06	Cm-243	3 E-14	5 E-08
Pm-147	3 E-10	1 E-04	Cm-244	4 E-14	6 E-08
Sm-151	4 E-10	4 E-04	Gross Alpha (as Am-241)	2 E-14	3 E-08
			Gross Beta (as Ra-228)	3 E-12	1 E-07

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* As transmitted by memorandum from John C. Tseng, Acting Director, Office of Environmental Guidance and Compliance, U.S. Department of Energy, dated November 4, 1987.

APPENDIX F
GLOSSARY, ACRONYMS, AND UNITS

GLOSSARY, ACRONYMS, AND CONVERSION TABLES

Aquifer - A permeable geologic unit that can transmit significant quantities of water.

Background Radiation - The radioactivity in the environment, including cosmic rays from space and radiation that exists elsewhere - in the air, in the earth, and in manmade materials that surround us. In the United States, the average person receives 300 millirem of background radiation per year.

Becquerel (Bq) - A unit of activity equal to one nuclear transformation per second ($1Bq = 1s^{-1}$) The former special-named unit of activity, the curie, is equal to 3.7×10^{10} Bq.

Confined Aquifer - An aquifer that is bounded above and below by less permeable layers. Ground water in the confined aquifer is under a pressure greater than the atmospheric pressure.

Cosmic Radiation - High-energy subatomic particles from outer space, which bombard the earth's atmosphere. Cosmic radiation is part of natural background radiation.

Counting Error - The variability caused by the inherent random nature of radioactive disintegration and the detection process.

Curie (Ci) - A unit of radioactivity equal to 37 billion (3.7×10^{10}) nuclear transformations per second.

Detection Level - The minimum concentration of a substance that can be measured with a 99 percent confidence that the analytical concentration is greater than zero.

Derived Concentration Guide (DCG) - Concentrations of radionuclides in air and water that under conditions of continuous exposure (365 d/yr) a person inhaling 8400 m^3 of air or ingesting 730 L of water per year would receive an annual effective dose equivalent rate of 100 mrem/yr from either mode of exposure. Committed dose equivalent is included for radionuclides with long, effective half lives.

Dispersion - The process whereby solutes are spread or mixed as they are transported by ground water as it moves through sediments.

Dosimeter - A portable device for measuring the total accumulate exposure to ionizing radiation.

Effective Dose - See "Effective Dose Equivalent" under "Radiation Dose."

Effluent - The liquid or gaseous waste streams released to the environment from a facility.

Effuent Monitoring - Sampling or measuring specific liquid or gaseous effuent streams for the presence of polluntants.

Exposure - Subjecting a target (usually living tissue) to radiation.

Fallout - Radioactive materials mixed into the earth's atmosphere following a nuclear explosion. Fallout constantly precipitates onto the earth.

Groundwater - Subsurface water that is in the pore spaces of soil and geologic units.

Half-life - The length of time in which any radioactive substance will lose one-half of its radioactivity. The half-life may vary in length from a fraction of a second to thousands of years.

Ion Exchange - The reversible exchange of ions contained in a crystal for different ions in solution without destroying the crystal structure or disturbing the electrical neutrality.

Isotope - Different forms of the same chemical element that are distinguished by having different numbers of neutrons in the nucleus. A single element may have many isotopes. For example, the three isotopes of hydrogen are protium, deuterium, and tritium.

Long-Lived Isotope - A radionuclide that decays at such a slow rate that a quantity of it will exist for an extended period (half-life is greater than 3 years).

Short-Lived Isotope - A radionuclide that decays so rapidly that a given quantity is transformed almost completely into decay products within a short period (half-life of 2 days or less).

Lacustrine Sediments - A sedimentary deposit consisting of material pertaining to, produced by, or formed in a lake or lakes.

Maximally Exposed Individual - A hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose equivalent.

Mean - The average value of a series of measurements.

Median - The middle value in a set of results when the data are ranked in increasing or decreasing order.

Millirem (mrem) - A unit of radiation dose equivalent that is equal to one one-thousandth of a rem. An individual member of the public can receive up to 500 millirems (mrem) per year according to DOE standards. This limit does not include radiation received for medical treatment or the 100 to 250 mrem that people receive annually from background radiation.

Minimum Detectable Concentration - The smallest amount or concentration of a radioactive or nonradioactive element that can be reliably detected in a sample.

Offsite Locations - Sampling and measurement locations outside the West Valley Demonstration Project boundaries.

Onsite Locations - Sampling and measurement locations within the West Valley Demonstration Project boundaries.

Outfall - The end of a drain or pipe that carries waste water or other effluents into a ditch, pond, or river.

Person-rem - See "Collective Dose Equivalent" under "Radiation Dose."

Plume - The distribution of a pollutant in air or water after being released from a source.

Radiation - Refers to the process of emitting energy in the form of rays or particles that are thrown off by disintegrating atoms. The rays or particles emitted may consist of alpha, beta, or gamma radiation.

Alpha Radiation - The least penetrating type of radiation. Alpha radiation can be stopped by a sheet of paper or outer dead layer of skin.

Beta Radiation - Emitted from a nucleus during fission. Beta radiation can be stopped by an inch of wood or a thin sheet of aluminum.

Gamma Radiation - A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require heavy shielding, such as concrete or steel, to be stopped.

Internal Radiation - Radiation originating from a source within the body as a result of the inhalation, ingestion, or implantation of natural or manmade radionuclides in body tissues.

Radiation Dose - For the purpose of this report, radiation doses are defined as follows:

Absorbed Dose - The amount of energy deposited by radiation in a given amount of material. Absorbed dose is measured in units of "rads" (see "Dose Equivalent").

Collective Dose Equivalent - The sum of the dose equivalents for individuals comprising a defined population. The per capita dose equivalent is the quotient of the collective dose equivalent divided by the population size.

Committed Dose Equivalent - The total dose equivalent accumulated in an organ or tissue in the 50 years following a single intake of radioactive materials into the body.

Cumulative Dose Equivalent - The total dose one could receive in a period of 50 years following release of the radionuclides to the environment, including the dose that could occur as a result of residual radionuclides remaining in the environment beyond the year of release.

Dose Equivalent - The product of the absorbed dose, the quality factor, and any other modifying factors. The dose equivalent is a quantity for comparing the biological effectiveness of different kinds of radiation on a common scale. The unit of dose equivalent is the rem. A millirem is one one-thousandth of a rem.

Effective Dose Equivalent - An estimate of the total risk of potential health effects from radiation exposure. It is the sum of the committed effective dose equivalent from internal deposition and the effective dose equivalent from external penetrating radiation received during a calendar year. The committee effective dose equivalent is the sum of the individual organ committed dose equivalents (50 year) multiplied by weighting factors that represent the proportion of the total random risk that each organ would receive from uniform irradiation of the whole body.

Radioactivity - A property possessed by some elements, such as uranium, whereby alpha, beta, or gamma rays are spontaneously emitted.

Radioisotope - A radioactive isotope of a specified element. Carbon-14 is a radioisotope of carbon. Tritium is a radioisotope of hydrogen.

Radionuclide - A radioactive nuclide. There are several hundred known nuclides, both manmade and naturally occurring; nuclides are characterized by the number of neutrons and protons in an atom's nucleus.

Rem - An acronym for Roentgen Equivalent Man; a unit of radiation exposure that indicates the potential impact on human cells.

Sievert - A unit of dose equivalent from the International System of Units (SI) equal to 1 joule per kilogram.

Spent Fuel - Nuclear fuel that has been exposed in a nuclear reactor; this fuel contains uranium, activation products, fission products, and plutonium.

Standard Deviation - An indication of the dispersion of a set of results around their average.

Standard Error of the Mean - An indication of the dispersion of an estimated mean from the average of other estimates of the same mean.

Thermoluminescent Dosimeter (TLD) - A material that, after being exposed to radiation, luminesces upon being heated. The amount of light emitted is proportional to the amount of radiation (dose) to which it has been exposed.

Unconfined Aquifer - Contains groundwater that is not confined above by relatively impermeable rocks. The pressure at the top of the unconfined aquifer is equal to that of the atmosphere.

Water Table - A theoretical surface which is represented by the elevation of water surfaces in wells penetrating only a short distance into the unconfined aquifer.

Whole-Body Dose - A radiation dose that involves exposure of the entire body.

X/Q - A dispersion factor calculated using an atmospheric dispersion model from average annual meteorological data. It is used to estimate the air concentration from the total airborne release of a radionuclide. The resulting estimates of average annual air concentrations at specific locations away from the source can be used to calculate potential doses.

ACRONYMS

ANOVA – One-way Variance of Analysis

ALARA – As Low As Reasonably Achievable

BEIR – Committee on Biological Effects of Ionizing Radiations

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CSS – Cement Solidification System

D&D – Decontamination and Decommissioning

DCG – Derived Concentration Guide

DE – Dose Equivalent

DOE – Department of Energy

DOE-HQ – Department of Energy, Headquarters Office

DOE-ID – Department of Energy, Idaho Project Office

EA – Environmental Assessment

EE – Environmental Evaluation

EIS – Environmental Impact Statement

ELAP – Environmental Laboratory Accreditation Program

EML – Environmental Measurements Laboratory

EMSL – Environmental Monitoring Systems Laboratory (Las Vegas)

EPA – Environmental Protection Agency

FONSI – Finding of No Signicant Impact

FY – Fiscal Year

HLW – High-Level Radioactive Waste

ICRP – Internation Commission on Radiological Protection

INEL – Idaho National Engineering Laboratory

IRTS – Integrated Radwaste Treatment System

LLD – Lower limit of detection

LLW – Low-Level Radioactive Waste

LLWTF – Low-Level Waste Treatment Facility

LWTS – Liquid Waste Treatment System

MDC – Minimum Detectable Concentration

NBS – National Bureau of Standards

NCRP – National Council on Radiation Protection and Measurements

NDA – Nuclear Regulatory Commission Licensed Disposal Area

NEPA – National Environmental Policy Act

NESHAP – National Emission Standards for Hazardous Pollutants

NFS – Nuclear Fuel Services Company

NOI – Notice of Intent

NRC – Nuclear Regulatory Commission

NWPA – Nuclear Waste Policy Act

NYSDEC – New York State Department of Environmental Conservation

NYSDOH – New York State Department of Health

NYSERDA – New York State Energy Research and Development Authority

NYSGS – New York State Geological Society

ORRB – Operational Readiness Review Board

OSR – Operational Safety Requirement

PNL – Pacific Northwest Laboratory

PVS – Permanent Ventilation Unit

QA – Quality Assurance

QAP – Quality Assurance Program

QC – Quality Control

RCRA – Resource Conservation and Recovery Act

SAR – Safety Analysis Report

SI – Internation System of Units (metric)

SPCC – Spill Prevention Control and Countermeasures

SPDES – State Pollution Discharge Elimination System

STS – Supernatant Treatment System

TLD – Thermoluminescent Dosimeter

TRU – Transuranic

USGS – U.S. Geological Survey

VF – Vitrification Facility

WNYNSC – Western New York Nuclear Service Center

WVDP – West Valley Demonstration Project

WVNS – West Valley Nuclear Services Company, Inc.

ABBREVIATIONS FOR UNITS OF MEASURE

Radioactivity and Dose

Symbol	Name
Ci	curie
mCi	millicurie (10 E-03 Ci)
μCi	microcurie (10 E-06 Ci)
nCi	nanocurie (10 E-09 Ci)
pCi	picocurie (10 E-12 Ci)
fCi	femtocurie (10 E-15 Ci)
aCi	attocurie (10 E-18 Ci)
Bq	becquerel
Sv	sievert
Gy	gray

Volume

Symbol	Name
cm^3	cubic centimeter
L	liter
mL	milliliter
m^3	cubic meter
ppm	parts per million
ppb	parts per billion

Length

Symbol	Name
km	kilometer (10 E03 m)
m	meter
cm	centimeter (10 E-02 m)
mm	millimeter (10 E-03 m)
m	micrometer (10 E-06 m)

Mass

Symbol	Name
g	gram
kg	kilogram (10 E03 g)
g	microgram (10 E-05 g)
ng	nanogram (10 E-09 g)
t	metric ton (or tonne; 10^3 kg)

Time

Symbol	Name
yr	year
d	day
h	hour
m	minute
s	second

Area

Symbol	Name
ha	hectare (10,000 m^2)

CONVERSION TABLE

Multiply	By	To Obtain	Multiply	By	To Obtain
in.	2.54	cm	cm	0.394	in.
ft	0.305	m	m	3.28	ft
mi	1.61	km	km	0.621	mi
lb	0.454	kg	kg	2.205	lb
liq qt	0.946	L	L	1.057	liq qt
ft^2	0.093	m^2	m^2	10.76	ft^2
ha	2.47	acres	acres	0.405	ha
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.7	ft^3
dpm	0.450	pCi	pCi	2.22	dpm
nCi	1000	pCi	pCi	0.001	nCi
pCi/L	10 E-09	Ci/mL	Ci/mL	10 E09	pCi/L
pCi/m^3	10 E-12	Ci/m^3	Ci/m^3	10 E12	pCi/m^3
becquerel	2.7 x 10 E-11	curie	curie	3.7 x 10 E10	becquerel
gray	100	rad	rad	0.01	gray
sievert	100	rem	rem	0.01	sievert
ppb	0.001	ppm	ppm	1000	ppb
ppm	1.0	mg/L	mg/L	1.0	ppm

TABLE OF UNIT PREFIXES

Factor	Prefix	Symbol
10 E09	giga	G
10 E06	mega	M
10 E03	kilo	k
10 E-02	centi	c
10 E-03	milli	m
10 E-06	micro	μ
10 E-09	nano	n
10 E-12	pico	p

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